

AMENDMENTS TO THE SPECIFICATION:

On page 1, immediately following the title, please insert headings as follows:

BACKGROUND OF THE INVENTION

Field of the Invention

The paragraph beginning on page 1, line 9 has been changed as follows:

The ~~present~~ invention relates to a method and an arrangement for the testing of substrates provided with a predetermined pattern, in particular circuit boards having an application of solder paste.

On page 1, line 13 please add a heading as follows:

Description of Related Technology

The paragraph beginning on page 2, line 10 has been changed as follows:

In the case of all methods, the layout of the circuit board should coincide exactly with the openings of the template. Since a secure soldering of components to the circuit board is only ensured ~~there~~ where sufficient solder paste is present, as a rule, directly after the application, the applied solder paste is checked for presence, offset and bridge building. Usually, in the screen printing machine, the layout of the circuit board is detected by means of a CCD camera and oriented in accordance with the template. Here, the software and the camera system are mostly so configured that with the same camera also a so-called post-printing check inspection can be carried out.

On page 2, line 35 please insert a heading as follows:

GENERAL DESCRIPTION OF THE INVENTION

The paragraphs beginning on page 2, line 36 have been changed as follows:

~~The object on which the invention is based is to indicate~~ provides a method and an arrangement for the testing of a substrate provided with a predetermined pattern, with which a rapid and nonetheless precise testing is possible.

~~This object is achieved in accordance with the features of the independent claims.~~
~~Thus~~ According to the invention, the actual pattern applied to the substrate by means of a printing or structuring process is optically detected, the optically detected actual pattern is compared with a desired pattern and dependent upon the comparison, and taking into account permissible tolerances, it is decided to which further process the observed substrate having the actual pattern is to be delivered, wherein the optical detection of the actual pattern is effected in the form of digital data with the formation of an actual data set, a desired data set is formatted from control data for the application of the pattern to the substrates, and data processing carried out to the effect that the desired set and the actual data set are compared datawise with one another, taking into account permissible tolerances. A teaching in process is thus not needed. This increases the precision of the testing, since the production of the desired pattern cannot be negatively influenced, as is the case with production by means of teaching in, by factors such as different environmental illumination and/or changes of the surfaces, contaminations and setting errors of the operator. The desired pattern can be produced in a short time for the entire circuit board, wherein the operator solely determines the areas on the circuit board relevant for the testing.

Please delete the paragraph beginning on page 5, line 4 as follows:

~~The invention is further developed by means of the features of the dependent claims.~~

On page 5, line 16 please insert a heading as follows:

BRIEF DESCRIPTION OF THE DRAWINGS

The paragraphs beginning on page 5, line 17 have been changed as follows:

The ~~present~~ invention will be described in more detail with reference to the accompanying drawings, in which ~~there is shown~~:

Fig. 1 shows the basic structure of a first exemplary embodiment for the testing of the pattern applied to a conductor board with solder paste, in accordance with the ~~present~~ invention, and

Fig. 2 shows a sub-division of the pattern applied to the circuit board into sub-patterns in accordance with a second exemplary embodiment of the ~~present~~ invention.

On page 5, line 29 please add a heading as follows:

DETAILED DESCRIPTION

The paragraphs beginning on page 5, line 30 have been changed as follows:

In the example shown in Fig. 1 an actual pattern 1a, for example a predetermined solder paste pattern, applied to a substrate such as a circuit board 1, is tested in accordance with the ~~present~~ invention. First, control data, by means of which the actual pattern 1a was generated on the circuit board 1, ~~is~~ are delivered to formatting means 2 (i.e., formatter). ~~This~~ These control data ~~is~~ are obtained, depending on the method of application of the actual pattern 1a onto the circuit board 1, directly from a plotter 3, which directly applies the actual pattern 1a, or from a databank 4, which e.g. contains the data for the production of a corresponding print template or the like by means of which the actual pattern 1a is applied (here not illustrated). The formatting means 2 recognizes the kind of the delivered control

data and formats a desired data set from the received control data corresponding to the requirements of a control unit 5. If, as is per se usual, a plurality of circuit boards 1 are to be produced with the same actual pattern 1a and tested, the thus produced desired data set is stored, so that the steps of reading in the control data and formatting a desired data set need only to be carried out once in the testing of a plurality of circuit boards 1.

In comparison with the conventional manner of proceeding for the production of desired patterns, in which prototypes for teaching purposes, or a template employed for production, are scanned by means of ~~the~~ a camera 6, the faults which necessarily arise in the detection, which is subject to error due to the relative movements, of prototypes which are themselves subject to error, or in the detection, subject to error due to the relative movement, of printing screens which are themselves possibly subject to error (even if to a lesser extent than in the case of prototypes) are here avoided, the data for control of the plotter 3, which is to apply the pattern, or the data for production of a template, such as a printing screen, corresponds fully to the desired pattern and beyond this is also available since it is generated by the developer.

At least the actual pattern 1a of the circuit board 1 patterned with the actual pattern 1a is scanned by a the camera 6, which optically detects the actual pattern applied to the circuit board 1 by means of the plotter 3 or the screen printing, in particular in form ~~and~~ of pixels, and this is passed on in the form of digital data to a converter 7. The converter 7 converts the actual pattern detected by the camera 6 into an actual data set, corresponding to the requirements of the control unit 5. The actual data set and the desired data set, and a tolerance data set made available by the control unit 5, which describes the permissible tolerances with respect to the desired data set, whereby such tolerances may indeed be different distributed over the desired pattern, are passed on and then delivered to a comparator 8, which taking into account the indicated permissible tolerances in the tolerance data set, compares or

correlates datawise the actual data set with the desired data set. The result of the comparison can be shown on a display 9. In particular in the case of an impermissible deviation of the actual pattern from the desired pattern, corresponding sections of the actual pattern can be represented with emphasis on the display 9, in order to make possible for the user an appropriate reaction.

The paragraph beginning on page 7, line 34 has been changed as follows:

In order to increase precision of the testing, in accordance with the ~~present~~ invention the nature of the actual pattern 1a on the circuit board 1 is taken into account in the testing in accordance with the invention, in that for example within the overall pattern in regions or sections having higher terminal density, e.g. at the locations where IC components are to be applied to the circuit board 1, a lower tolerance is given with regard to the actual/desired offset than in regions with lower terminal density, e.g. at the locations where resistances and capacitors are to be applied to the circuit board 1. The selection of the regions and the association of the respective tolerances can be effected automatically or by means of the operator.

The paragraph beginning on page 9, line 22 has been changed as follows:

Further, it may be necessary, if the circuit board 1 onto which the pattern to be tested (e.g. of solder paste) is applied, itself already carries another pattern (e.g. a printed circuit) to discriminate the actual pattern 1a to be tested against this other pattern on the circuit board 1. In accordance with the ~~present~~ invention, for this purpose on the one hand the information is obtained in simple manner from the control data by means of which the actual pattern 1a to be tested was generated on the circuit board 1, wherein on the other hand the camera 6 carries out an optical discrimination of the actual pattern not only with respect to the circuit board 1 but also with respect to this other pattern.

The paragraph beginning on page 11, line 36 has been changed as follows:

The ~~present~~ invention is not restricted to the described application for the testing of circuit boards but can rather be applied advantageously anywhere where the patterning/structuring/patterning of parts with a predetermined pattern is to be tested. In the described examples the tolerance data sets for the comparison of the desired data set with the actual data set are delivered to the comparator 8. It is however also possible that already in the formatting of the desired data set and/or in the formation of the actual data set the permissible tolerances are to be taken into account.